



**TECHNICAL MEMORANDUM  
EVALUATION OF REMAINING BENZNE  
AT THE DEFUELING UST SITE (ST-06)  
O'HARE ARS - CHICAGO, ILLINOIS**

On May 2, 1997, the Illinois Environmental Protection Agency (IEPA) issued an interim No Further Action (NFA) letter to the United States Air Force (Air Force) for the Defueling Underground Storage Tank (UST) Site (IRP-ST-06) at the Former O'Hare Air Reserve Station (ARS). The NFA was contingent upon the determination of Class II Groundwater Resource at the ARS. However, investigations completed to date have not successfully demonstrated that the groundwater at the ARS is a Class II Groundwater Resource. Therefore, consistent with previous risk evaluations for the TCE Site (SS-019) and Former Incinerator Site (IN-018), the Air Force is evaluating potential risk at ST-06 in accordance with 35 Illinois Administrative Code (IAC) 742 assuming a Class I Groundwater Resource. The evaluation is presented in this Technical Memorandum. During this risk evaluation, the closest distance from IRP-ST-06 to the Town of Des Plaines property boundary was found to be greater than 2,500 feet (See Figure 1). Because the distance from the site to the Town of Des Plaines property boundary is greater than 2,500 feet, evaluation of the site was not required in accordance with 35 Illinois Administrative Code (IAC) Part 742, Section 742.32(d). The Town of Des Plaines property boundary was used for the calculation for the reasons stated in Item 2 below. However, to be conservative in evaluating the potential risks, TACO Tier 1 and Tier 2 evaluations were conducted for the site.

Tables 1 and 2 summarize the analytical data results from soil and groundwater samples at ST-06. This data was obtained from the Final Site Classification Completion Report for the Defueling UST Site (Montgomery Watson, February 1997). The tables also contain a comparison of the results with the 35 IAC 742 (also known as Tiered Approach to Corrective Action Objectives - TACO) Tier 1 Soil and Groundwater Remediation Objectives for industrial/commercial properties with a Class I Groundwater Resource. Based on this comparison, there were two benzene exceedences of the soil component of the groundwater ingestion exposure for Class I groundwater in the soil sample results and four benzene exceedences of the remediation objectives for Class I groundwater in the groundwater sample results.

To further evaluate the potential risk from benzene in groundwater at ST-06, a TACO Tier 2 evaluation was conducted using the R-26 equation for the ARS's upper and lower water bearing zones. The evaluations are presented as an attachment to this memorandum. The following site-specific information was used in calculating the R-26 equation based results.

1. The maximum soil and groundwater benzene concentrations were used in calculations. The maximum benzene concentration in soil was 0.08 milligrams per kilogram (mg/kg) at sample location B-2 at 3 to 5 feet below ground surface

(bgs). The maximum benzene concentration in groundwater was 0.02 milligrams per liter (mg/l) at sample location GB-8A.

2. The City of Chicago and the Village of Rosemont both have Memoranda of Understanding with the State of Illinois that restricts the installation and usage of potable groundwater wells within their boundaries. The former O'Hare ARS property also has an IEPA-approved restriction for the installation and usage of potable groundwater wells on the property. Therefore, the nearest point for a potential receptor for ingestion of groundwater is the southern border of the Town of Des Plaines which is adjacent to the northern border of the Former ARS. The distance from the ST-06 site to this boundary is 2,603 feet. This is shown on Figure 1.
3. The site-specific hydraulic conductivity value used is  $1.5 \times 10^{-4}$ . This hydraulic conductivity value is from hydraulic conductivity tests performed at the ARS in 2000 (Report of Hydraulic Conductivity Tests for SS-019, Montgomery Watson 2000) and the response to comments for this report submitted by the Air Force on December 20, 2000.

As the calculations indicate, the highest benzene concentration in soil of 0.08 mg/kg would result in a benzene groundwater concentration of  $2.0 \times 10^{-44}$  mg/L in the upper aquifer and  $1.3 \times 10^{-59}$  mg/L in the lower aquifer at the compliance point. The highest concentration in the groundwater of 0.02 mg/L would result in a concentration of  $5.0 \times 10^{-45}$  mg/L in the upper aquifer and  $3.3 \times 10^{-60}$  mg/L in the lower aquifer at the compliance point. All of these are below the TACO Class I groundwater standard of 0.005 mg/L. Therefore, ST-06 does not pose an unacceptable risk to a Class I or Class II Groundwater Resource.

Table 1  
1997 Site Classification Report Groundwater Results  
IRP-ST-06  
Former O'Hare Air Reserve Station  
Chicago, Illinois

Compound	Groundwater Remediation Objective - Class I (mg/L)	MW1	MW2	MW3	MW4	MW5	MW6	B-5	B-6	B-7	B-8	GB-8A	GB-9	GB-10	GB-11	GB-12	GB-13	GB-14
Benzene	0.005	ND	ND	ND	ND	ND	ND	ND	0.001	0.002	<b>0.011</b>	<b>0.02</b>	<b>0.014</b>	ND	<b>0.011</b>	ND	0.002	0.003
Ethylbenzene	0.7	ND	ND	ND	ND	ND	ND	0.001	0.001	0.01	ND	ND	0.016	ND	ND	ND	ND	0.001
Toluene	1	ND	ND	ND	ND	ND	ND	0.006	0.003	0.006	ND	0.09	0.001	0.01	0.011	0.002	0.009	0.008
Xylenes	10	ND	ND	ND	ND	ND	ND	0.01	0.004	0.005	0.041	0.5	0.021	0.028	0.013	ND	0.016	0.012
Total BTEX	--	NA	NA	NA	NA	NA	NA	0.017	0.009	0.023	0.052	0.61	0.052	0.038	0.035	0.002	0.027	0.024
Naphthalene	1	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	--	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenphthene	2	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	0.28	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	0.21	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	0.1	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	0.00013	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	0.00018	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	0.00017	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	0.0002	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.00043	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	0.0003	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	--	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:  
All results presented in mg/L  
**Bold results indicate an exceedence of the remediation objective**  
-- = No standard exists for this compound  
ND = the sample was non-detect for this compound  
NA = the sample was not analyzed for this compound

Compound	Soil Component of the Groundwater Ingestion Exposure Route Values - Class I (mg/kg)	B-1 (0-1ft)	GB-11 S2 (4-6ft)	GB-12 S3 (5-7ft)	GB-13 S1 (2-4ft)	GB-13 S2 (4-6ft)	GB-14 S2 (3-5ft)
Benzene	0.03	N	ND	ND	0.006	NS	ND
Ethylbenzene	13	0	ND	ND	0.027	NS	ND
Toluene	12	0	ND	ND	0.03	NS	0.003
Xylenes	150	0	ND	ND	0.11	NS	ND
Total BTEX	--	0	ND	ND	0.173	NS	0.003
Naphthalene	84	N	NS	NS	NS	NS	
Anthracene	12,000	1	ND	0.28	NS	0.13	ND
Fluoranthene	4,300	2	ND	2.2	NS	0.77	0.18
Fluorene	560	N	ND	0.35	NS	ND	ND
Pyrene	4,200	2	ND	1.7	NS	0.61	0.13
Chrysene	160	0	ND	0.57	NS	0.26	ND
Benzo(a)anthracene	2		0.0069	0.63	NS	0.31	0.0083
Benzo(b)fluoranthene	5	0	0.0091	0.52	NS	0.23	0.017
Benzo(k)fluoranthene	49	0	ND	0.25	NS	0.12	0.0052
Benzo(a)pyrene	8	0	0.0053	0.45	NS	0.24	ND
Indeno(1,2,3-cd)pyrene	14	0	0.007	0.29	NS	0.13	0.0062
Dibenzo(a,h)anthracene	2	0	0.012	0.2	NS	0.11	0.0095
Benzo(g,h,i)perylene	--	0	ND	0.27	NS	0.14	ND
Phenanthrene	--	2	ND	2.5	NS	0.44	0.18

Notes:

All results presented in mg/L

**Bold results indicate an exceedence of the remediation of**

-- = No standard exists for this compound

ND = the sample was non-detect for this compound

NA = the sample was not analyzed for this compound

CONCENTRATION IN GROUNDWATER AT THE COMPLIANCE POINT  
ST-06 - O'HARE AIR RESERVE STATION  
3/31/2004

WATER-BEARING ZONE:  
CONTAMINANT OF CONCERN:

**UPPER**  
**Benzene**

Soil Conc.	0.08	Assumed residual concentration in soil after removal action (CUO)	mg/kg
LF <sub>sw</sub>	1	Leaching factor from soil to groundwater (per instruction)	mg/L water / mg/kg soil
C <sub>source</sub>	0.08	Concentration in groundwater under the source B-2 (calculated at LF <sub>sw</sub> = 1, per instruction)	mg/L
X	2603	Distance to compliance point (from ST-06 to Town of Des Plaines border)	ft
	79339.44		cm
Sw	40	Source width perpendicular to groundwater flow direction in horizontal plane (assumed from soil boring location map)	ft
	1219.2		cm
Sd	200	Source width perpendicular to groundwater flow direction in vertical plane (by TACO default)	cm
K	1.50E-04	Aquifer hydraulic conductivity (value presented U.S. Air Force response to Agency comments dated December 20, 2000)	cm/sec
	1.30E+01		cm/day
i	0.00262	Hydraulic gradient (site-specific, calculated from ERM/United piezometric data)	cm/cm
theta t	0.43	Total porosity (by TACO default)	cm <sup>3</sup> /cm <sup>3</sup>
U	7.90E-02	Specific discharge, calculated from TACO Appendix C Table C Equation R19; k*i/theta t	cm/day
erf		Error function (from TACO Appendix C Table G)	unitless
alpha x	7934	Longitudinal dispersivity (calculated by TACO Equation R16; 0.10 * X)	cm
alpha y	2645	Transverse dispersivity (calculated by TACO Equation R17; $\alpha x/3$ )	cm
alpha z	397	Vertical dispersivity (calculated by TACO Equation R18; $\alpha x/20$ )	cm
lambda	0.0009	First order degradation constant, 1/d (chemical specific value from TACO Appendix C Table E)	
exp	6.69E-40	Exponential function calculated per R26.	
erf1	2.10E-02	First error factor, calculated per R26.	
erf2	1.78E-02	Second error factor, calculated per R26.	
C(x)	2.0E-44	Concentration in groundwater at the compliance point	mg/L
	0.005	Class I Groundwater Standard (from TACO Table E)	mg/L

RESULT:

**LESS THAN**

CLASS I GROUNDWATER STANDARD AT THE ASSUMED POINT OF COMPLIANCE

CONCENTRATION IN GROUNDWATER AT THE COMPLIANCE POINT  
ST-06 - O'HARE AIR RESERVE STATION  
3/31/2004

WATER-BEARING ZONE:  
CONTAMINANT OF CONCERN:

**LOWER**  
**Benzene**

Soil Conc.	0.08	Assumed residual concentration in soil after removal action (CUO)	mg/kg
LF <sub>sw</sub>	1	Leaching factor from soil to groundwater (per instruction)	mg/L water / mg/kg soil
C <sub>source</sub>	0.08	Concentration in groundwater under the source B-2 (calculated at LF <sub>sw</sub> = 1, per instruction)	mg/L
X	2603	Distance to compliance point (from ST-06 to Town of Des Plaines border)	ft
	79339.44		cm
Sw	40	Source width perpendicular to groundwater flow direction in horizontal plane (assumed from soil boring location map)	ft
	1219.2		cm
Sd	200	Source width perpendicular to groundwater flow direction in vertical plane (by TACO default)	cm
K	1.5E-04	Aquifer hydraulic conductivity (value presented U.S. Air Force response to Agency comments dated December 20, 2000)	cm/sec
	1.30E+01		cm/day
i	0.0014	Hydraulic gradient (site-specific, calculated from ERM/United piezometric data)	cm/cm
theta <sub>t</sub>	0.43	Total porosity (by TACO default)	cm <sup>3</sup> /cm <sup>3</sup>
U	4.22E-02	Specific discharge, calculated from TACO Appendix C Table C Equation R19, k <sup>2</sup> i/theta <sub>t</sub>	cm/day
alpha <sub>x</sub>	7934	Longitudinal dispersivity (calculated by TACO Equation R16, 0.10 * X)	cm
alpha <sub>y</sub>	2645	Transverse dispersivity (calculated by TACO Equation R17, b <sub>x</sub> /3)	cm
alpha <sub>z</sub>	397	Vertical dispersivity (calculated by TACO Equation R18, b <sub>z</sub> /20)	cm
lambda	0.0009	First order degradation constant, 1/d (chemical specific value from TACO Appendix C Table E)	
exp	4.33E-55	Exponential function calculated per R26	
erf1	2.10E-02	First error factor, calculated per R26	
erf2	1.78E-02	Second error factor, calculated per R26	
C(x)	1.3E-59	Concentration in groundwater at the compliance point	mg/L
	0.005	Class I Groundwater Standard (from TACO Table B)	mg/L

RESULT

**LESS THAN**

CLASS I GROUNDWATER STANDARD AT THE ASSUMED POINT OF COMPLIANCE

CONCENTRATION IN GROUNDWATER AT THE COMPLIANCE POINT  
ST-06 - O'HARE AIR RESERVE STATION  
3/31/2004

WATER-BEARING ZONE:  
CONTAMINANT OF CONCERN

UPPER  
**Benzene**

GW Conc.	0.020	Assumed residual concentration in soil after removal action (CUO)	mg/L
LF <sub>sw</sub>	1	Leaching factor from soil to groundwater (per instruction)	mg/L water / mg/kg soil
C <sub>source</sub>	0.020	Concentration in groundwater under the source GB-8A	mg/L
X	2603	Distance to compliance point (from ST-06 to Town of Des Plaines border)	ft
	79339.44		cm
Sw	40	Source width perpendicular to groundwater flow direction in horizontal plane (assumed from groundwater monitoring well location map)	ft
	1219.2		cm
Sd	200	Source width perpendicular to groundwater flow direction in vertical plane (by TACO default)	cm
K	1.50E-04	Aquifer hydraulic conductivity (value presented U.S. Air Force response to Agency comments dated December 20, 2000)	cm/sec
	1.30E+01		cm/day
i	0.00262	Hydraulic gradient (site-specific, calculated from ERM/United piezometric data)	cm/cm
theta i	0.43	Total porosity (by TACO default)	cm <sup>3</sup> /cm <sup>3</sup>
U	7.90E-02	Specific discharge, calculated from TACO Appendix C Table C Equation R19, $k^*i/\theta i$	cm/day
erf		Error function (from TACO Appendix C Table G)	unitless
alpha x	7934	Longitudinal dispersivity (calculated by TACO Equation R16; $0.10 * X$ )	cm
alpha y	2645	Transverse dispersivity (calculated by TACO Equation R17; $(1/x/3)$ )	cm
alpha z	397	Vertical dispersivity (calculated by TACO Equation R18; $(1/x/20)$ )	cm
lamdba	0.0009	First order degradation constant, 1/d (chemical specific value from TACO Appendix C Table E)	
exp	6.69E-40	Exponential function calculated per R26.	
erf1	2.10E-02	First error factor, calculated per R26.	
erf2	1.78E-02	Second error factor, calculated per R26.	
C(x)	5.0E-45	Concentration in groundwater at the compliance point	mg/L
	0.005	Class I Groundwater Standard (from TACO Table E)	mg/L

RESULT

**LESS THAN**

CLASS I GROUNDWATER STANDARD AT THE ASSUMED POINT OF COMPLIANCE

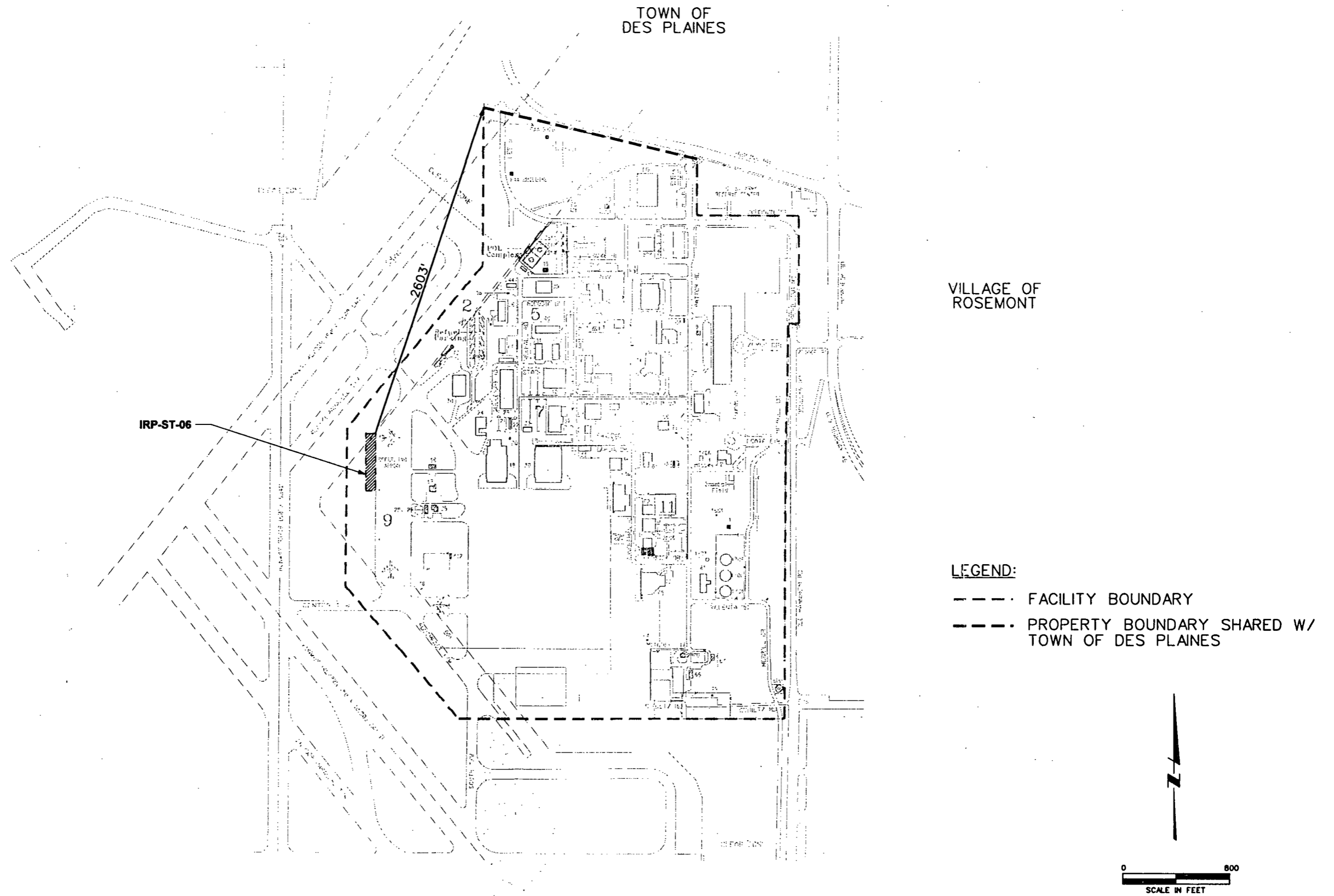
GROUNDWATER AT THE COMPLIANCE POINT  
ST-06 - O'HARE AIR RESERVE STATION  
3/31/2004

WATER-BEARING ZONE:  
CONTAMINANT OF CONCERN:

**LOWER**  
**Benzene**

GW Conc.	0.02	Assumed residual concentration in soil after removal action (CUO)	mg/L
LF <sub>sw</sub>	1	Leaching factor from soil to groundwater (per instruction)	mg/L water / mg/kg soil
C <sub>source</sub>	0.020	Concentration in groundwater under the source GB-8A	mg/L
X	2603	Distance to compliance point (from ST-06 to Town of Des Plaines border)	ft
	79339.44		cm
Sw	40	Source width perpendicular to groundwater flow direction in horizontal plane (assumed from groundwater monitoring well location map)	ft
	1219.2		cm
Sd	200	Source width perpendicular to groundwater flow direction in vertical plane (by TACO default)	cm
K	1.5E-04	Aquifer hydraulic conductivity (value presented U.S. Air Force response to Agency comments dated December 20, 2000)	cm/sec
	1.30E+01		cm/day
i	0.0014	Hydraulic gradient (site-specific, calculated from ERM/United piezometric data)	cm/cm
theta t	0.43	Total porosity (by TACO default)	cm <sup>3</sup> /cm <sup>3</sup>
U	4.22E-02	Specific discharge, calculated from TACO Appendix C Table C Equation R19; $k^*i/\theta t$	cm/day
alpha x	7934	Longitudinal dispersivity (calculated by TACO Equation R16; $0.10 * X$ )	cm
alpha y	2645	Transverse dispersivity (calculated by TACO Equation R17; $lx/3$ )	cm
alpha z	397	Vertical dispersivity (calculated by TACO Equation R18; $lx/20$ )	cm
lambda	0.0009	First order degradation constant, 1/d (chemical specific value from TACO Appendix C Table E)	
exp	4.33E-55	Exponential function calculated per R26.	
erf1	2.10E-02	First error factor, calculated per R26.	
erf2	1.78E-02	Second error factor, calculated per R26.	
C(x)	3.3E-60	Concentration in groundwater at the compliance point	mg/L
	0.005	Class I Groundwater Standard (from TACO Table B)	mg/L

RESULT: **LESS THAN** CLASS I GROUNDWATER STANDARD AT THE ASSUMED POINT OF COMPLIANCE



SCALE  
1" = 800'



O'HARE AIR RESERVE STATION  
CHICAGO, ILLINOIS

FIGURE  
1